Phase-2 Project Summary

Firm: Radiation Monitoring Devices, Inc.
Contract Number: NNX13CM33C
Project Title: Next generation gamma/neutron detectors for planetary science

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)
Gamma ray and neutron spectroscopy are well-established techniques for determining the chemical composition of planetary surfaces, atmospheres, and small cosmic bodies such as asteroids and comets; however, new technologies with the potential to significantly improve the performance of planetary nuclear spectroscopy are emerging in response to demands in other fields such as homeland security. We propose to develop new gamma-ray and neutron detectors based on wide-band-gap (WBG) solid state photomultiplier (SSPM™) photodetector that can be coupled to emerging scintillation materials such as Cs_2YLiCl_6:Ce (CLYC) and CeBr3 for gamma and neutron spectroscopic studies of small planetary bodies.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)
The goal of the Phase-II program is to develop a gamma/neutron detector prototype using wide-band-gap AlGaAs-based SSPM coupled to emerging scintillation materials that provide dual gamma/neutron discrimination, compact size, better noise performance, low power consumption, radiation hardness, and good energy resolution. The major technical objectives achieved in this program are:
• Optimize process recipe for AlGaAs GPD and SSPM fabrication
• Provide an AlGaAs GPD with high sensitivity in blue/UV range.
• Provide advanced scintillation detector prototype.

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)
The following list summarizes the accomplishments and milestones met by the Phase-2 effort.
• Optimized fabrication recipe for AlGaAs diodes with low dark currents.
• Design and fabrication process for optimized quantum efficiency from AlGaAs diode.
• Demonstration of Geiger mode operation.
• Demonstration of GPD with low dark count rates and high quantum efficiency from 350 nm to 450 nm.
• Demonstration of high-energy resolution with advanced scintillation materials (e.g. CLYC, $CeBr_3$).

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)
The proposed innovative technology is a suitable component for a gamma-ray and neutron spectrometer that can be used for Earth science missions, planetary missions, exploration of small cosmic bodies such as asteroids and comets, satellite radio-imaging, and space exploration probes. The nature of the detectors, as having a high signal-to-noise ratio, excellent energy resolution, low power consumption, and resiliency to harsh radiation environments, can open the door for improved gamma and neutron spectroscopy in future NASA planetary missions.

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)
The development of the new gamma-ray and neutron detectors has a myriad of applications in the science, homeland security, and medical fields. The AlGaAs SSPM, with its low thermal noise and radiation hardness, makes it an excellent photodetector for scintillation detection of high energy x-rays, gammas, neutrons, and protons in nuclear and high-energy physics experiments. The instrument can also be used for detecting and monitoring of radioactive materials for homeland security, and in medical imaging applications such as Positron Emission Tomography and Single Photon Emission Computed Tomography.

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